Weapons and Munitions of War

Field Equipment for Signal Troops

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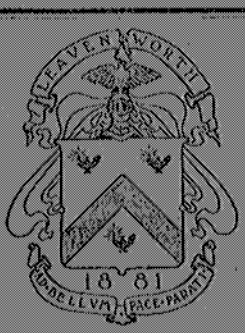

Army School of the Line

Department of Military Art

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FIELD EQUIPMENT OF SIGNAL TROOPS*

By Major C. McK. Saltzman, Signal Corps, U. S. Army.

One of the most important duties performed on the battle field is that of the transmission of orders or information. A British military authority has said that "the success of important operations mainly depends on the rapid transmission of orders and information in war". History records the story of battles lost by superior trained forces due to failures in the prompt transmission of orders.

The Russo-Japanese war presented on more than one occasion, the spectacle of a fighting line covering more than twenty-five miles of territory. In wars of the present and future with such extended lines, one of the cares which will give the greatest concern to the commanding general, will be that of keeping in constant communication with the larger units of his command.

With small commands and where shorter distances are involved, a messenger can deliver orders and messages more satisfactorily than any other agent but where the commanders of the larger units of an army in the field are separated by miles, a quicker agent than the messenger must be furnished. When time is a consideration, electricity is the swift accurate messenger which now conducts the commer-

*Complied for use in connection witn practical demonstrations with the apparatus described.

cial business of the world. As time is an important factor in war, electricity must be similarly utilized on the battlefield.

In the Russo-Japanese war, great dependence was placed in the use of the telegraph and the telephone by both contestants. At Mukden, General Nogi's Third Army which formed the Japanese left, laid during that battle one hundred and fifty-five miles of field wire and at Lioyang, Field Marshal Oyama controlled his entire force by wire from his headquarters twelve miles to the rear of the firing line.

Any army waging war under modern conditions, must have electrical means of inter-communication between its commander and the larger units of the command. These means of communication must be reliable and certain, and the equipment must be sufficiently mobile to follow the higher commanders wherever they go and to quickly establish communication.

A chain of electrical communications must be efficiently maintained to enable the supreme commander to have the necessary control over his force to insure united action. Referring to control and united action, a British military authority says: "There is no salvation for an army, however brave, however well trained to fight, which, on the field of battle has to trust to the blind and semi-independent work of isolated units, if it is opposed by a combined force of an equally capable army acting as a whole under the well informed guidance of its supreme leader."

In our army, the duty of providing the means of inter-communication in the field devolves on the Signal Corps. It is its first and most important duty. Electrical means are utilized to transmit the information or orders and the lines over which the intelligence passes are called "lines of information".

In furnishing lines of information years ago, dependence was placed on aerial lines with the wires elevated on light poles called lance poles. Construction of these lines, known as "lance lines," required many wagons, much material, and so much time that the line could not be built as fast as the command moved. The commanding general to-day cannot wait until a lance line is built up to his position. He requires immediate communication. To supply his needs in the field of active operations, the lances or poles are dispensed with and the lines are laid on the ground from automatic appliances which can move at a trot or even at a gallop and follow the general wherever he goes. These lines laid on the ground are called "field lines". For the purpose of developing the use of these field lines of information, of perfecting mobile equipment for their construction, and for instructing officers of the line of the army and of the Signal Corps in their use, the Army Signal School was established in 1905.

As an army moves into hostile territory today, its commander must be keep in constant communication with his base and the seat of government by lines of information. If they exist, the ordinary telegraph or telephone lines of the country will be utilized for this purpose. If such do not exist, field lines will be rapidly laid on the ground as fast as the army moves. If these lines are to be used for some time, signal troops following the army, will elevate these wires on poles thus transforming them into lines of a more permanent and substantial character. As the army approaches its enemy, the commanding general must be kept in constant communication with his corps commanders who in turn must be in communication with their division commanders. When deployment is made, the division commanders will require his signal troops to keep him in touch

with his brigade commanders and with his artillery. Special cases will arise when other lines must be rapidly laid to meet conditions.

For a number of years, large sums of money have been expended by the Signal Corps in designing and furnishing electrical appliances for the systems of fire control and direction for sea coast artillery and recently steps have been taken to provide similar means of inter-communication of a mobile type for field artillery. At the artillery maneuvers at Fort Riley, Kansas, 1907, a trained company from the Signal School was detailed for duty with the artillery. The artillery commander located himself at the most favorable observing station regardless of the distance from the guns and by means of lines of information was kept in constant communication with his battalion commanders thereby enabling him to exercise control over fire and direction. In siege operations in the future, great use will be made of electrical lines of information in connection with the artillery. It is safe to say that every battery will be connected to a system of wires which will enable one central intelligence at headquarters to exercise complete control over fire and direction.

In order to perform this technical duty in the field, signal troops must be organized into regular companies of fixed strength and trained during time of peace for the same reason that field artillery troops are organized into batteries and do not exist as a general corps or detachment. In order to install and operate field lines of information, certain duties must be assigned to certain men, exactly as different men have different duties in aiming and firing a gun in a field battery. These signal companies must, therefore, be permanently organized with a fixed strength and the organization must be drilled and trained as a unit, if efficient work is expected. The proper train-

ing of these companies and the proper use of their lines of information can only be attained by constant co-operation between the troops that are to do the fighting and the troops that are to provide the lines. They must serve together, not occasionally at annual maneuver camps, but constantly at large posts. The signal troops must study to serve the fighting troops and the fighting troops must make the proper use of the lines provided.

On September 16, 1907, the Acting Secretary of War approved the following as a provisional organization for the Signal Corps serving with a division of troops in the field:

3 captains
9 lieutenants
9 master signal electricians
30 sergeants, first class
30 sergeants
30 corporals
135 privates, first class
60 privates
6 cooks

For the purpose of administration, these men may be organized into companies of such strength as to best meet existing conditions.

The following transportation is provisionally approved for the Signal Corps troops attached to a division:

100 riding horses
6 reel carts, 2 horses each
5 wire wagons, 4 mules each
7 lance trucks, 4 mules each
6 instrument wagons, 2 mules each
3 instrument wagons, 4 mules each
6 construction wagons (escort), 4 mules each
4 escort wagons (general transportation), 4 mules each
9 pack mules

The following rules are important in the use of field lines:

1. Don't burden the wires with messages to a commander one-half mile distant. An orderly can deliver the message quicker.

2. Don't dictate your telegrams to the operator. Write out your telegram on a blank form.

3. Make your meaning clear with as few words as possible. The wires will be crowded with messages. Don't sign your message "John Jones, Colonel, 8th Cavalry, Chief of Staff, 2d Division, 5th Corps," when "Jones, Chief of Staff," will suffice.

4. Don't tell the operator that your message is important and must be rushed. Everyone gives him this information. All war messages are important. If your telegram is specially important, mark it "urgent" and call his attention to that fact.

As to the apparatus used in maintaining communication, the following shows their relative degree of usefulness:

1. The buzzer
2. The telephone
4. Wireless telegraphy
5. Visual signaling

LINES OF INFORMATION

As regards their *construction*, lines of information are divided into three classes, known as permanent lines, semi-permanent lines, and field lines.

Permanent lines are those built as nearly as possible like the ordinary commercial telephone and telegraph lines with ordinary galvanized iron or copper wires elevated on heavy substantial poles and are ordinarily used for telegraph communication.

Semi-permanent Lines are those of more hasty construction, with the ordinary iron or copper wires elevated on trees or light wooden lance poles. A trained company of the signal corps can build about ten miles of lance line in one day if the country is fairly open and level, but if the work is to be continued for some time, difficulties in securing adequate transportation to bring forward supplies, will lessen the number of miles built per day. A lance truck

drawn by four mules holds about three hundred lances. Semi-permanent lines are ordinarily used for telephone or telegraph communication.

Field lines are of insulated or partially insulated wire laid on the ground and are ordinarily used for buzzer communication. Field lines will be described in more detail later on.

As regards their *use,* lines of information are divided into two classes known as strategical lines and tactical lines.

Stategical lines are those behind an army, connecting its headquarters with its base or with the seat of the government. In the operations of the army of the Potomac in 1865, the telegraph lines which connected General Grant's headquarters with Washington were strategical lines. Strategical lines will usually be the ordinary commercial telegraph lines of the country, or, in their absence, may consist of "permanent" or "semi-permanent" lines built for the purpose. On these strategical lines the ordinary commercial telegraph instruments, known as the relay, the sounder, and the key will usually be used, although the telephone may be used instead.

Tactical lines are those lines laid for the purpose of maintaining communication between different units of an army. These lines will ordinarily be "field" lines hastily laid on the ground. The buzzer will be the instrument ordinarily employed on these lines.

FIELD LINES

Field lines are of two classes known as "Field Wire Lines" and "Buzzer Wire Lines."

Field wire is composed of eleven small wires twisted together and covered with a tough insulation. This wire has great tensile strength and is not harmed by wagons and troops passing over, it is very pli-

able, and if laid with sufficient "slack" will conform to the irregularities of the surface of the ground. In connecting buzzers or telephones to field wire, the insulation should be scraped off that portion of the wire to be fastened to the binding posts. Field wire may be laid at a trot or gallop from wire carts with large reels which hold about eight miles of wire and which are drawn by two mules. These carts can be used in automatically reeling up the wire if circumstances permit of its recovery. In laying the wire, a mounted man rides behind the cart. The man is equipped with a light wooden lance on the end of which is a special hook. By means of this lance the wire is picked up and thrown out of the road from under the feet of passing troops and vehicles.

Troops finding field wire lines cut or broken should tie the two wires together by a good hard knot at a point about a foot from the end of each, the insulation on the end of each wire should then be scraped back for about two inches and the bare wires themselves twisted or tied together.

Buzzer wire consists of three small wires twisted together and covered with a partial insulation. Buzzer wire is issued on steel spools containing about one-half mile of wire,—the weight of both wire and spool is about five pounds. These spools fit into special reels carried by a mounted man who is able to allow the wire to reel out as he moves at a trot or gallop.

Field wire will ordinarily be used on tactical lines but in special cases, when lines must be laid very rapidly or when they must be laid on ground over which two-wheeled carts cannot well be taken, buzzer wire is used.

THE BUZZER

The electric telegraph is the most reliable means

of transmitting information over long distances in the field when exactness is required and when the information transmitted should be a matter of record. The ordinary telegraph system that is used on commercial telegraph lines requires large batteries, well insulated lines, careful adjustments of instruments, and many office conveniences. This system is therefore not suited for use on tactical lines which ordinarily will be hastily laid on the ground, will often times be poorly insulated, and which may be operated from offices established along a trail or in a fence corner. To avoid the necessity for large batteries, permanent office conveniences, etc., the Signal Corps has developed, for use on tactical lines, an instrument called the buzzer, which operates on a different principle from the ordinary telegraph instruments of commerce. This instrument can be used in sending messages over hastily laid, poorly insulated lines where ordinary commercial instruments would be useless. It has been used to send messages over "lines" consisting of barbed wire fences and of short stretches of railroad track. Buzzers are built in small leather covered cases which contain the battery and all other technical apparatus necessary to open a station on a field line. In addition to the buzzer proper, the case contains also a telephone set which provides telephonic communication when the instrument is not being used for "buzzer telegraphy." If it is desired to open a field office on a line, it is only necessary to connect one binding post to the line and the other binding post to a metal peg driven into the earth. With these two connections made, information can be transmitted by "buzzer telegraphy" or by telephone. If it is desired to use the telephone, a switch connected with the transmitter circuit must be pressed down while talking. If this switch is not pressed down, speech will not be transmitted. In

sending messages by means of "buzzer telegraphy," the letters of each word are sent on a simple telegraph key, making use of the ordinary Morse telegraph code.

Buzzers are issued in two forms, the field buzzer and the cavalry buzzer. Both types are built on the same principle and serve the same purpose. The cavalry buzzer is, however, put up in more compact form, is lighter, and is well adapted for the use of mounted troops.

The buzzer is the most valuable field instrument of the Signal Corps and provides for both telegraph and telephone communication in the field. Every regiment should be issued a limited number of these simple instruments with a suitable supply of buzzer wire for various uses which will suggest themselves to line officers.

BRIEF SUMMARY OF THE USEFULNESS AND EFFICIENCY OF THE BUZZER

(*a*) The buzzer with its leather case is a miniature telegraph office especially designed for use in sending telegrams over hastily built, poorly insulated lines laid on the ground, where ordinary telegraph instruments of commercial type would be useless.

(*b*) Buzzers are issued in two forms, the field buzzer and the cavalry buzzer.

(*c*) Both forms are built for field service and both can be quickly connected to a field line.

(*d*) The cavalry buzzer is light and can easily be carried by a mounted man.

(*e*) Both forms of buzzer include an efficient telephone set which can be used as such when the "buzzer telegraph" is not being used.

THE FIELD TELEPHONE

The ordinary commercial telephone instruments are not sufficiently substantial nor built in suitable

form to withstand the hard usuage of a campaign. For this reason, an instrument known as the Signal Corps "field telephone" has been designed and is issued. The field telephone is compactly built in a wooden, iron-bound, weather-proof box, which can be carried by means of a strap slung over the shoulder. The battery and all other apparatus necessary for the operation of one field telephone station is contained inside the box. To open a station on a field line, it is only necessary to connect one binding post to the line wire, and the other binding post to a metal peg or rod driven into damp earth. The transmitter and receiver of the telephone are mounted on a metal bar which is held in the hand while in use. This metal bar also contains a switch, which must be depressed by a finger of the hand holding the bar, while the speaker talks into the transmitter. If this switch is not constantly depressed, the speech will not be transmitted to the distant station. Inside the lid of the case there is a simple wiring diagram of the telephone connections inside the box. Should any of these connections become broken through accident, it is possible to find a man in almost every company or troop who has sufficient knowledge of telephony to understand this simple diagram and repair the instrument.

The field telephone can be used on any kind of a line—permanent, semi-permanent or field. If the line is laid on the ground and poorly insulated, the service will not be good and dependence should be put in the use of the buzzer.

When several telephones converge to one headquarters in the field and a "central" is needed, a small, portable field telephone switchboard is issued. A system of "wireless telephony" has been invented, but is not sufficiently developed at the present time to be of practical value for field service.

The use of the telephone in the field has the following advantages:

(*a*) It does not require trained operators.

(*b*) It permits direct and confidential conversation between commanding officers and others, without intervention of other persons.

The use of the telephone in the field has the following disadvantages:

(*a*) It is not as reliable in the field as in commercial life, due to the noises and confusion which disturb the listener and which do not exist in civil offices or residences.

(*b*) It is not as accurate as the buzzer, because, in using the latter, messages are recorded by letter.

(*c*) Experience in field exercises at Fort Leavenworth has proved that when telephone messages have to be recorded as received, the use of the telephone is slower than the buzzer.

(*d*) Enlisted men who ordinarily transmit telephone messages have but a limited knowledge of military terms and expressions. In the confusion and noise of the battlefield, an unfamiliar term sounds to the listener like some other word of similar sound, but which may have a different meaning, and the soldier records the incorrect word.

It can be laid down as a rule that when the telephone communication is accomplished thru soldiers, the information or messages to be transmitted should always be written on message blanks and handed to the operator.

FIELD WIRELESS TELEGRAPHY

The transportation of the wire necessary for field lines and the maintenance of the wire line between stations presents obstacles to reliability and efficiency. Wireless telegraphy, which is being developed very rapidly, will, undoubtedly, be of great use in trans-

mitting information in military operations of the future. At present, it is an auxiliary means of maintaining communication in the field. In the recent Russo-Japanese War, field wireless was used with little success. The U. S. army, however, has more efficient field wireless equipment to-day than was used in Manchuria during the war.

Between *permanent stations*, wireless telegraphy is no longer an experiment, but a reliable means of communication. Whenever wireless stations of somewhat *permanent* nature can be established in the field, the use of this system is very efficient to supplement wire service. With a large army in the field to-day, wireless stations would be useful at army headquarters to communicate with the base, with naval stations and vessels and possibly with corps headquarters, whenever wire service is not available.

But for stations in front of corps headquarters, where quick service is imperative and where stations must be moved rapidly to follow the tide of battle or the movements of the commander, wireless telegraphy is not suitable to-day, due to certain difficulties, which may be overcome to-morrow. No man knows what to-morrow may bring forth in the possibilities of wireless telegraphy.

The enemy will undoutedly read some of our wireless messages and disturb our stations. We must, therefore, have an efficient system, read his messages and disturb his stations.

Much time and money has been expended by the Signal Corps in developing field wireless sets. Each new development and discovery in the science has been quickly seized and embodied in our equipment. The field sets issued in November, 1906, are now obsolete and have been replaced by new sets which in turn may be considered inefficient in a few months.

The present standard field set can be carried on three pack mules. One mule carries the operating chest, which contains the sending and receiving apparatus, one mule carries two chests containing storage batteries, while the third mule carries joints of a sixty-foot wooden pole which can be elevated by sections and guyed by strong cords. Using these sets, messages can be exchanged between stations twenty-four miles distant.

BRIEF SUMMARY OF THE STATUS OF WIRELESS TELEGRAPHY

Although wireless telegraphy between permanent stations is a reliable, efficient means of communication, the system in its present state of development is but an auxiliary method for field service. When stations of somewhat permanent nature can be maintained, the system is valuable at the headquarters of an army for communication with its base, with naval stations, or possibly with corps headquarters when wire service is not available. The present Signal Corps field set can be transported on three pack mules and is efficient over twenty-four miles distance. At present, the enemy will probably read some of our wireless messages and disturb our stations. Our army must, therefore, be prepared to read the enemy's messages and disturb his stations.

CIPHERS

A cipher a is secret mode of writing. Important messages which might fall into the hands of the enemy or signal messages which might be read by him, should be enciphered. There are two simple means of enciphering messages, viz; by means of the cipher disk and by means of the route cipher.

The cipher disk is composed of two circular disks of card board or other material joined concentrically, the upper disk revolving upon the lower. The diame-

ter of the upper disk is made less than that of the lower disk. The alphabet, reading clockwise, and such other signals, numerals, or combinations of letters, as may be desired, are printed around the circumference of the lower disk. On the upper disk are also printed the alphabet, and the other signals, numerals, and combinations of letters, except that they are printed counter-clockwise.

If it is desired to encipher a message in the simplest manner with this disk, a "key" letter is agreed upon beforehand, and the message enciphered as follows: Place the "key" letter of either one of the disks opposite "A" of the other disk. With the disks in this fixed relation, read in succession the letters on one disk opposite the letters occuring in the message to be sent in regular succession as found on the other disk. This will give evidently a succession of letters having no meaning until deciphered by the reverse process at the receiving station. To further complicate it, it is usual to arbitrarily break up the cipher letters thus obtained into uniform groups of four or five letters each, regardless of the number of letters in the separate words of the message. Messages enciphered in this simple manner are very easy to decipher, but the process can be made more difficult by adopting a key word or sentence instead of a key letter, when the setting of the disk is changed as each letter is enciphered. Great ingenuity has been displayed in enciphering military messages in the past, and although an expert can ultimately work out the "key" to almost any system devised, yet the time required to accomplish this can easily be made so great as to practically destroy the value of the information when obtained.

To encipher a message by means of the route cipher, the words of the message are first arranged in accordance with a preconcerted agreement in columns

of two, three or more words each. The message is then enciphered by writing in order, the first word of column, next the second word of each column, and so on; or by interchanging the column, or by inserting "blind" words as may be agreed upon previously.

CODES.

Message codes are devised for use in field service in order that preconcerted phrases may be expeditiously transmitted. Between stations, where it would be necessary to send messages of great importance in the shortest possible time, codes are arranged in sentences, and opposite each sentence are placed several letters of the alphabet or a word to designate it, Such conventional signals serve a most useful purpose in time of war,

An efficient code known as the "War Department Telegraph Code" has been prepared by the signal corps by order of the Secretary of War. It is issued for official use and is in the nature of a confidential document. The code contains the names of all officers and organizations in the army, all words, and expressions that might be used in active operations. Before each word or expression, is its code word. This code can also be used as a cipher for secrecy. Full instructions for its use are contained in the front page of the book.

FIELD-GLASSES AND TELESCOPES

There is no more generally useful part of the equipment of an officer than an efficient field-glass.

The human eye is the standard upon which are based the qualities of field-glasses and telescopes. The properties of these instruments are therefore expressed generally in terms of power, field, light and definition, There are but two general types of field glasses, the Galilean and the Prismatic, although there are many makes of each type. The Signal Corps for

a number of years conducted experiments with a view to determining the best types of field-glasses and telescopes for issue to the service. The general results of these tests clearly show that no one type of either gives satisfaction under all circumstances. Varying conditions of temperature, humidity, and clearness of atmosphere, require different types. The most important property of a glass is its definition, that is, the sharpness of the image seen through it, yet the properties of power, light, and field are but little less important.

No single field-glass can furnish a maximum result as to these four properties, and in consequence all glasses must be compromises. For instance, if the "power" of the glass is increased, the "field" will be decreased, If "light" is increased, some other property must suffer.

In addition, whether a glass is held by a mounted man with a free hand, by one on foot, or in a holder, makes a difference as to the power which can be advantageously used. The best that can be done is to select certain standard glasses, leaving the individual free to utilize the special advantages of the glass most nearly suited to his eyes, position, locality and special needs.

The Signal Corps Day and Night field-glass, Model 1905, is the result of the efforts of the Signal Corps to provide a field glass that will meet the greatest variety of conditions, and insure efficient service to the greatest number of military observers. It is really two glasses in one, namely, a day glass of medium power, and a night glass of low power, This glass is a very good one for moderate ranges, but it does not replace under special conditions for long ranges, either the Porro-prism glass or the telescope. This double glass is secured by interposing automatically, just in front of the eye-pieces, small plus lenses

which operate to change the power. All that is necessary to change the glass from a day glass to a night glass is to turn it over, since the operation of interposing the lenses is accomplished automatically by gravity. A different adjustment of the tubes is, however, required to get the proper focus for each.

For military purposes, a field telescope must have suitable form, small volume, and little weight, and, in addition, must be capable of being used without support if necessary, mounted or dismounted, and also the image must appear erect. For general signal purposes, a telescope of a power of about thirty, with the best definition and light obtainable under these requirements, has been found most satisfactory. The Signal Office at present issues field telescopes of 18 and of 24-power, with tripod complete packed in a leather carrying case.

VISUAL SIGNALING

Electrical means of communication have very largely superseded visual methods in the field, yet occasions may arise when the use of visual signaling may be the only practical means of transmitting information over considerable distances. The principal field visual signal apparatus used by signal troops consist of the flag and heliograph for day signaling and the acetylene lantern for night signaling. In sending messages by means of these instruments, the words of the messages are sent letter by letter by means of the Army and Navy code (sometimes known as the "Myer code"). This code is composed of three elements represented by the numbers 1, 2, and 3. These figures or elements are arranged into combinations to represent each letter of the alphabet, the numerals, and certain conventional signs. Each element may be signaled by a certain motion of the flag or by flashes of light.

Rockets and bombs are sometimes used for visual signaling. They are ordinarily employed to display some preconcerted signal, although the rockets can be used to signal individual letters by displaying different colored lights in sequence to represent the different elements of the letter.

Visual signal stations will ordinarily be established on high points to which wagons cannot be taken. To provide for more mobile transportation, pack chests have been designed which contain all the apparatus necessary for day or night signaling at one station, and which may be transported on pack mules.

THE FLAG

Flags are issued in three sizes and are of different colors, The color to be used in signaling depends on the background behind the signalist, the object being to obtain the greatest contrast between the flag and the background. The greater the distance to be signaled over, the longer should be the staff supporting the flag and the larger should be the flag. Fog, rain, darkness, and other unfavorable conditions limit the speed of flag signaling and the distance over which it is efficient.

THE HELIOGRAPH

The heliograph is an instrument for reflecting a beam of sunlight to a distant station by means of plain, adjustable mirrors. A shutter or screen is placed near the mirror between it and the distant station. By opening and closing this shutter, the reflected sunlight either passes to the distant station or is obscured from it. Thus, by opening and closing the shutter, certain combinations of flashes are seen at the distant station, the combinations representing letters, numerals, or conventional signals of the code. Under favorable conditions, messages can be sent by

heliograph at a rate from seven to ten words per minute. Heliograph messages have been sent over one hundred and fifty miles.

With good sunlight the heliograph is far superior to the flag. It permits more rapid communication and its range is much greater. Dust and smoke which would obscure the flag are penetrated by the flash of the heliograph.

The *advantages* of the heliograph are its portability, its great range, the rapidity with which it can be operated, and the fact that its flashes can only be seen by those approximately in a right line joining the two stations.

THE ACETYLENE LANTERN

This night-signaling device is a substantial lantern specially designed for field service, is provided with a strong reflector, and is equipped for burning acetylene gas. It can be mounted on the ordinary heliograph tripod. With the lamp are furnished small tin cartridges containing calcium carbide. When calcium carbide is brought in contact with water, acetylene gas is generated. In operating the lantern, a calcium carbide cartridge is placed in the lantern generator which has previously been filled with water, the gas commences to generate at once and is conducted to the burners through tubes for that purpose. The signals are made by depressing a lever key which looks and operates like an ordinary telegraph key. Depressing the key allows an increased amount of gas to flow into the burners and a bright flash is seen at the distant station. This lantern is the most reliable of the visual signaling apparatus and has been used in flashing messages over thirty miles. Fog, rain, and bright moonlight are the principal impedements to its use. Trained men can work it efficiently at a rate of from five to eight words per minute.

MILITARY AERONAUTICS

At the present moment, the subject of military aeronautics, or aerial navagation, is receiving much attention in all the large foreign armies. The air may be navigated by means of ordinary balloons (captive or free), dirigible balloons, and aeroplanes.

Captive balloons. In all large foreign armies, considerable attention is paid to the use of ordinary captive balloons with troops in campaign and these armies have regular organized balloon troops, trained to transport, inflate, and maneuver army ballons. The French successfully used military balloons for making reconaissances as early as 1794 at the Battle of Fleuris. The defeat of the Austrians was, in a great measure, due to information secured by the use of balloons. Napoleon took a balloon corps to Egypt in his Egyptian campaign of 1798. During the nineteenth century, they were used in many campaigns. The English transported from London to the heart of Africa, balloons and supplies of hydrogen gas compressed at very high pressure in steel tubes. Of their use, Lord Roberts says: "The captive balloons gave us great assistance in keeping us informed of the disposition and movements of the enemy."

A trained balloon company provided with compressed gas can inflate and elevate a captive balloon in less than an hour. It can be elevated or lowered, and when elevated can be towed wherever desired. The vulnerability of captive balloons has been determined by numerous experiments conducted by many nations, during a number of years. Extensive experiments were conducted in England in 1899. Rifle fire does little damage to balloons. Shrapnel fire alone is dangerous to the gas bag. It is proved that a balloon elevated about 1,500 feet and three miles distant from the enemy's guns is safe from artillery fire.

Military value of captive balloons. The captive balloon is valuable mainly for reconnaissance. An observer at an elevation of fifteen hundred feet sees spread out before him a picture of the country. At that height, under ordinary atmospheric conditions, the observer with a field glass can see the surrounding country within a radius of five miles sufficiently well to make trustworthy reconnaissance reports. The elevation enables him to see particularly well all roads and trails, as they actually exist, and all of the enemy's force within five miles, not concealed in forests. He can make a fairly accurate estimate of the enemy's strength, his disposition, and movements. He can communicate with those below by telephone, can send below sketches of the country, and can photograph the country by means of special cameras. Wet prints of these photographs can be made in less than thirty minutes. It is claimed that captive balloons betray the position of the force using them. In reply, it may be said that an army of sufficient size to employ a balloon train will surely betray its presence at least at the distance of a day's march, regardless of balloons, while a captive balloon can give the enemy no correct idea of the composition, strength or disposition of the force using it. The advantages obtained from its proper use greatly outweigh any knowledge it may give the enemy.

Free balloons. Inability to determine the course or destination of free balloons limits their use in warfare. Free balloons have found their most important application in fortress warfare in enabling the besieged to escape to their friends, or in carrying messages, as in the Siege of Paris.

DIRIGIBLE BALLOONS.

The dirigible balloon consists of a cigar shaped gas bag from which is suspended a light frame work containing an engine which turns a propeller.

Dirigible balloons have just passed the experimental stage. Under ordinary atmospheric conditions, they can be steered in any desired direction for several hours. Their future development depends mainly on the development of light but powerful gas engines. England, Germany, and France already have powerful dirigible balloons. In France, certain fortresses have a powerful dirigible balloon assigned to each as a part of their equipment. In a short time, they will be considered a practical necessity for all armies.

STATUS of BALLOONING in the U. S. ARMY.

The Signal Corps has recently purchased several large military balloons made in this country and is training officers and men in their use. Inability to obtain hydrogen gas in this country has limited ballooning to larger cities where the best quality of coal gas can be obtained from city mains. A large hydrogen gas generating plant is now being constructed at the Signal Corps post at Fort Omaha, Neb. The gas generated will be compressed at very high pressure in steel tubes which can be transported in the field. The system of compressing gas for field service is followed in the European armies. On the completion of this gas generating plant the use of captive, free, and dirigible balloons will be extended in the U. S. Army.

AEROPLANES

The aeroplane is a flying machine built on the "heavier than air" principle. It has no balloon attached. Altho aeroplanes have been made in many shapes and forms, all may be likened to a large box kite provided with an engine and a propeller. The aeroplane is in an experimental stage and has no military value at present. Its use in war, when completed is problematical. Probably the most success-

ful flying machine yet made is the creation of the Wright brothers of Dayton, Ohio. Their machine consists of two superposed aeroplanes and weighs complete with its engine about one thousand pounds. The Wrights have made several successful flights near Dayton at various elevations. They have been able to move their machine in circles, describe a figure eight, remain in flight thirty eight minutes and have attained a speed of thirty five miles per hour.

On October 28, 1907, an International Aeronautical Congress of the World met in New York City. It was attend by representatives of the Army and Navy and by other government officials and scientists from various countries. It was repeatedly stated at this Congress that the success of aerial navigation is established and that in a few years, war crafts will navigate the air as well as the water.

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